DIMENSIONAL ANALYSIS, THE METRIC SYSTEM AND SIGNIFICANT FIGURES

Exponents

The rules:

What is an exponent?

10^6 means 10 times itself 6 times.

Multiplying numbers with exponents:

$$a^r \,!\, a^s = a^{r+s}$$

this means:

$$10^3 \cdot 10^4 = 10^{3+4} = 10^7$$

$$10^{-3} \cdot 10^4 = 10^{-3+4} = 10^1 = 10$$

but what is the meaning of 10^{-3}?

= ——

Dividing numbers with exponents:

$$\frac{a^r}{a^s} = a^{r-s}$$

$$10^{-3} \cdot 10^4 = \frac{10^4}{10^3} = \frac{10^{3+1}}{10^3} = 10^1 = 10$$ (write it out with 10s)

Raising numbers with exponents to other powers:

$$(a^r)^s = a^{rs}$$

$$(10^4)^3 = 10^{(4!3)} = 10^{12}$$

why? $10^4 \cdot 10^4 \cdot 10^4 = 10^{4+4+4}$

and

4 3 (4 (3)) 12 $\frac{1}{10^{12}}$

Significant Figures

Do a bunch of examples of numbers and how many sig figs they have

26 ! 2	2006 ! 4	2600 ! 2
0.4 ! 1	0.00004 ! 1	0.400 ! 3
7400 ! 2	7400. ! 4	

For multiplication and division, do all your steps, then look at what you started with. Whichever number has the fewest, that's how many your answer has.

Also, don't round off (up) till the end!

For subtraction and addition, the rules are a little more complex… but here's a couple of ways to look at it:

You can't add a new decimal place. If one is lost, a sigfig is lost…

213.2 – 172.5 = 40.7

You can't add precision.

130.1 + 0.002 = 130.1

Nor do you need to take it away needlessly.

162-3 = 159 (accuracy here is in the "ones" column)

So, how do you know how many digits to write down when you MAKE a measurement?

Digital?

Steady? Write down all numbers

Fluctuating? Take all steady numbers and estimate the next one smaller

Analog?

Take all numbers that have a scale (tick mark, line, etc.) and estimate the next one smaller

There are a few special cases… IGNORE the sig figs of

1. constants (pi, speed of light, etc.)
2. ratios of integers (1:2 molar ratio)

3. defined numbers (1 hogshead = 63 gallons)

Now, let's look at the Metric System:

Just go straight off the handout…

Ok, now we're ready to combine them.

Let's return to the question on the diagnostic:

If 1 cm = 0.01 m, then 1 cm^3 = how many m^3?

So, if 1 cm = 10^{-2} , then (1 cm)^3 = $\left(10^{-2} m\right)^3 = 10^{-6} m^3$

Now, if a cell is 10 m wide, 10 m tall and 20

3) Calculate the quantity of heat that must be transferred to 15.0 g of water to raise its temperature from 20.0 °C to 50.0 °C?

(Water has a specific heat of 4.18 $\frac{\text{J}}{\text{g} \cdot \text{°C}}$)

Heat transferred = (specific heat)(mass)(ΔT)

ΔT = 30.0 °C